UTILIZATION OF SPACE BY CAPTIVE GROUPS OF LOWLAND GORILLAS (*GORILLA G. GORILLA*)[1]

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ABSTRACT. Juvenile lowland gorillas caged together in 2 groups at Cincinnati Zoo displayed habitual use of particular cage sections. Dominant larger gorillas limited their space use more than did smaller gorillas.

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INTRODUCTION

Territoriality and dominance behavior are 2 methods by which animals control resource allocation among conspecifics. Many studies of vertebrates show that a defense of given areas and a dominance hierarchy exist as 2 points on a continuum of behavior that is dependent upon density (Wilson 1975). Generally, a population that exhibits territories at lower densities will shift toward dominance behavior at higher densities. The banded knife-fish, *Gymnotus carapo*, is the only vertebrate known to display the reverse behavioral scaling: from dominance orders at lower densities toward territories at higher densities (Black-Cleworth 1970). At low densities in an aquarium, the dominant knife-fish tour the tank with few challenges from lower-ranking knife fish. When challenges increase due to higher populations in the aquarium, the higher-ranking fish spend more time in their preferred areas, thereby decreasing aggressive interactions with subordinates.

Several investigations of mammals have determined that increased densities in confined populations result in a shift from space-associated behavior toward dominance behavior (Wilson 1975). On the other hand, dominance behavior is normal in a group-living mammal such as the gorilla (Schaller 1963). The present study

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was designed to determine if gorillas, like banded knife-fish, exhibit habitual use of particular spatial locations when confined in an enclosure. The subjects of the study were juvenile lowland gorillas housed at Cincinnati Zoo.

METHODS AND MATERIALS

Cincinnati Zoo recorded 4 successful births of lowland gorillas (*Gorilla g. gorilla*) in 1970 and 1971. The birth dates were 23 January 1970 for male Sam, 31 January 1970 for female Samantha, 12 July 1971 for male Ramses, and 12 September 1971 for female Kamari. The 4 animals were first housed together during 1974. They were observed from 21 December 1974 through 20 March 1975 (period 1), and from 1 October through 28 October 1975 (period 2).

Three female gorillas were born at the zoo in 1973 and 1974. The birth dates were 1 January 1973 for Amani, 15 April 1974 for Tara, and 21 August 1974 for Mata Hari. The animals were caged together during 1977. They were observed from 13 November through 10 December 1977 (period 3).

The gorillas' cage consisted of a public-viewing compartment, approximately 3.9 × 3.3 × 4.6 m, and a retreat compartment, approximately 1.5 × 1.2 × 1.2 m. By using the cage's bars and wall tiles as visual cues, the public-viewing compartment was divided into 36 units, each approximately 1.3 × 1.1 × 1.1 m. Seven of the units could not be occupied due to their lack of bars, chains or platforms for supporting the gorillas. The remaining 29 units and the retreat compartment were each identified by a site number for observation purposes (fig. 1). Sites 1-9 were in the south section of the cage, 10-18 were in the middle, and 19-30 were in the north. Sites 1-5, 10-12, and 19-22 were in the west section; 6-7, 13-15, and 23-26 were in the center; 8-9, 16-18, and 27-30 were in the east.

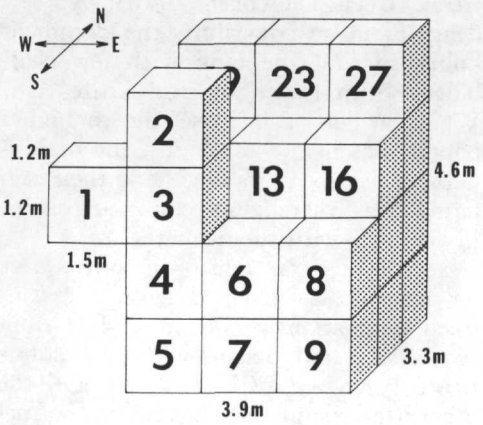

FIGURE 1. Diagram of cage, with retreat compartment (site 1) and public-viewing compartment (sites 2-30).

Data were collected during 1218 minutes of period 1, 494 minutes of period 2, and 1727 minutes of period 3. A time sampling technique was employed, wherein records were made of the gorillas' locations as the second hand passed the minute mark. All observations were made between 9.00 and 16.00 EST.

The "spread of participation index," a numerical measure of spatial behavior (Dickens 1955, Sundstrom and Altman 1974), was calculated for each subject for each of the observation periods 1-3. The index is calculated by the formula:

$$S = \frac{M(n_b - n_a) + (F_a - F_b)}{2(N - M)}$$

where

N = total number of observations of the subject;

M = mean frequency of observations in all of the cage sites $= \frac{N}{\text{number of sites}}$;

n_b = number of sites with frequencies less than M;

n_a = number of sites with frequencies greater than M;

F_a = total number of observations in sites with frequencies greater than M;

F_b = total number of observations in sites with frequencies less than M.

The spread of participation index ranges from zero to an upper limit of one. Low scores indicate equal usage of many sites. The higher the score, the greater the tendency of a subject to use just a few sites. An index of 1.0 indicates a subject's use of a single site.

RESULTS

Spread of participation index values are listed in table 1. During the 2 periods when Sam, Samantha, Ramses and Kamari were observed, the mean index values were 0.547 and 0.563. The slight rise in the index during period 2 suggests that the subjects made more frequent use of particular sites than during period 1. However, a paired t-test indicated that the period 2 increase was not significant.

Sam, Samantha, Ramses and Kamari each spent more time in the west section of

TABLE 1
Spread of participation index values.

Period:	1	2		3
Samantha	0.676	0.654	Amani	0.626
Sam	0.559	0.586	Tara	0.617
Kamari	0.489	0.534	Mata Hari	0.514
Ramses	0.465	0.477		

the cage than in the east or center sections. In a north-south orientation, however, Kamari was the most common resident of the south section, Ramses mostly occupied the north section, and Sam and Samantha spent most of their time in the middle section (fig. 2). During period 3, Amani, Tara and Mata Hari spent more time in the north section than in the south or middle sections. From an east-west aspect, however, the most common resident in the west section was Amani, in the east was Tara, and in the center was Mata Hari (fig. 3).

DISCUSSION

The gorillas displayed habitual use of particular sections of their enclosure. Of 7 subjects, 2 exhibited the same spatial preferences. Sam and Samantha spent approximately ½ of their time in the middle section, ⅓ in the south, and ⅙ in the north (fig. 2). The two gorillas were 8 days apart in age, and had been raised together since their births (Lotshaw 1971). The spatial affinity of Sam and Samantha is consistent with field observations that gorillas familiar with each other from immaturity spend more time together than do gorillas that did not know each other in immaturity (Harcourt 1979).

The subjects' frequent use of certain sites was quantified by their spread of participation index values (table 1). The values, all between 0.4 and 0.7, indicate that there was an uneven distribution of locational data for each of the gorillas. The index values also disclose a positive relationship between body size and the degree to which a subject limited his space use. Sam and Samantha had higher index values than did the smaller Ramses and Kamari during both periods 1 and 2. At the end of period 2, Sam and Samantha each weighed 45 kg, and Ramses and Kamari each weighed 29 kg. Amani had a higher index value than did Tara or Mata Hari during period 3. At the end of period 3, Amani weighed 45 kg, and Tara and Mata Hari each weighed 32 kg.

Within groups of juvenile gorillas, body size is positively correlated with status in the dominance hierarchy (Schaller 1963, Freeman and Alcock 1973). On the basis of interactions shown in response to food, Sam and Samantha were dominant over Ramses and Kamari, and Amani was dominant over Tara and Mata Hari.

Fischer and Nadler (1977, 1978) have pointed out that spacing in a wild gorilla group is facilitated by dominance behavior. A less dominant member avoids the space around a dominant animal. Size dominance might also be related to spacing in

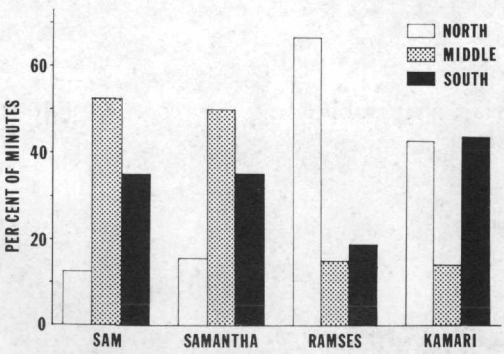

FIGURE 2. Number of minute intervals during which a gorilla was located in north, middle and south cage sections, expressed as a percentage of the number of minute intervals for which the gorilla was watched.

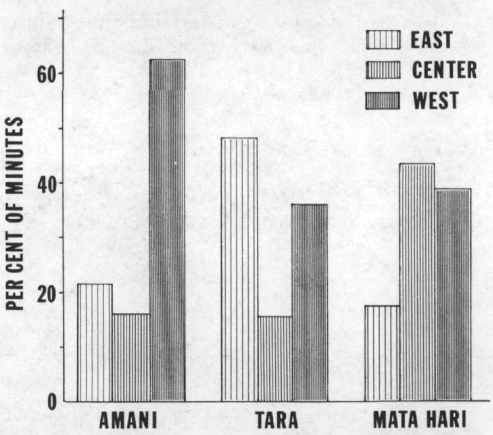

FIGURE 3. Number of minute intervals during which a gorilla was located in east, center and west cage sections, expressed as a percentage of the number of minute intervals for which the gorilla was watched.

caged groups of gorillas. As in a free-ranging troop, a larger dominant gorilla in a confined group may occupy a space that he prefers, leaving the subordinates to distribute themselves throughout the remainder of the cage. Although the dominant animal is able to roam the entire cage, there is a positive relationship between dominance rank and frequent use of certain areas. Consistent with this idea, a study of male prison inmates found that dominant group members were most mobile and also claimed the most desirable places (Austin and Bates 1974). In other confined human groups, dominant members most frequently used the preferable areas in a rehabilitation center cottage (Sundstrom and Altman 1974) and in summer camp cabins (Blood and Livant 1957, Savin-Williams 1977).

In restricted groups of banded knifefish, dominant individuals toured their entire enclosure, but preferred certain areas (Black-Cleworth 1970). Likewise, gorillas in the present study displayed habitual use of particular sections of their enclosure. The dominant larger gorillas limited their space use more than did the smaller gorillas.

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ERRATUM

On page 200 (*Ohio J. Sci.*, 1981, Vol. 81) under subheading *Gomphonema* Ehr., *Gomphonema* var. *elongatum* (Mayer)

should read

Gomphonema affine var. *elongatum* (Mayer) Millie & Lowe comb. nov.